



Coliform-Infected Dairy Cows

John Kirk

Department of Large Animal Clinical Sciences

Roger Mellenberger

Department of Animal Science

Michigan State University

Escherichia coli, *Enterobacteri aerogenes* and *Klebsiella pneumoniae* are three common forms of coliform bacteria that cause mastitis (inflammation of the udder) in dairy cows. This bulletin will focus on the source of coliform infections within a dairy herd and suggest useful control and prevention tips for dairy farmers.

Where can coliform bacteria be found on the farm?

Coliform bacteria are normal inhabitants of soil and the intestines of cows. They accumulate and multiply in manure, polluted water, and contaminated bedding. Research has shown that coliform numbers of 1,000,000 or more per gram of bedding increase the likelihood of an udder infection.

Klebsiella pneumoniae is common when farmers use sawdust bedding, especially rough-cut sawdust that contains bark or soil. Finer sawdust—especially hardwood sawdust—can increase the risk of coliform mastitis. The initial moisture level of the sawdust, however, has little effect on whether coliform numbers will exceed the 1,000,000 per gram level once the sawdust is used for bedding. *E. coli* and other coliforms are normally found in cow feces, and once the bedding (sawdust or other) becomes heavily soiled with cow manure, the coli-

form level will increase, and so will the chance of a coliform mastitis case occurring.

How do coliform infections start?

Many factors are involved in the initiation of a coliform infection. Unlike other major forms of mastitis, coliform infections are not usually spread from infected cows to non-infected cows during milking. Coliforms invade the udder through the teat when a cow comes in contact with an unsanitary environment between milkings.

Once coliforms enter the mammary gland, they multiply rapidly. As they multiply, coliforms produce endotoxins (poisons), which are subsequently released when the bacteria are destroyed by leucocytes (white blood cells). Once released from the bacteria, the toxins are absorbed into the bloodstream. A cow affected by the toxins will show signs of high fever, depressed appetite, rapid weight loss, abnormal milk and decreased production.

The majority of severe clinical infections occur by 70 to 90 days into a lactation. Most of the severe outbreaks of acute clinical mastitis caused by coliforms occur in highest producing, older cows. These cows typically are *Strep. ag.*- and *Staph. aureus*-free, and they have somatic cell counts below 200,000 (DHIA linear score 4). About 30 to 50 percent of these

cases actually start at the end of the previous dry period or during calving. Some of these infections are spontaneously cured, while others remain non-clinical until they flare up early in the lactation.

Periods of hot, humid weather, extensive periods of heavy precipitation, and movement of cows to new facilities are often followed by periods of increased incidence of new coliform cases.

How widespread can coliform mastitis be within a herd?

Coliform bacteria are responsible for a great number of acute clinical mastitis cases in dairy cows. Coliform infections generally occur as isolated or sporadic cases, but within certain herds, 10 to 15 percent of the cows may become infected within a time period as short as one month or less.

Even though coliforms may cause a high percent of all acute clinical cases, these organisms are responsible for only 0.1 to 1.0 percent of the total infected quarters within a herd at any one time. In addition, usually only one quarter per cow is clinically infected at a time.

What are the results of coliform infections?

Results of infections range from death of a cow to near-normal recovery of milk production. In about 70 percent of coliform

ST. PAUL CAMPUS
LIBRARIES

cases, infected cows may survive, but subsequent milk production will be below normal for the lactation. Some surviving cows may undergo a long illness, characterized by a poor appetite and weight loss. These cows should be sent to market after antibiotic residues are cleared. In about 10 percent of clinical coliform mastitis cases, cows die within one to two days after the infection becomes apparent, in spite of aggressive veterinary care. In the remaining instances (about 20 to 30 percent), cows recover quickly and return to substantial milk flow. Cows kept for another lactation usually return to near-normal production if swelling of the infected quarter returns to normal within 24 to 36 hours after the onset of clinical signs.

Few infections become chronic, and those that do are usually very mild. In rare instances, coliform bacteria have been found to cause non-clinical problems on a herd basis.

What signs might tip me off that a coliform mastitis problem is present within my herd?

Individual cow signs:

In a typical case, an individual cow with a severe coliform infection will suddenly go off feed and become depressed after being clinically normal at the previous milking. The infected quarter will swell and milk may become watery. Body temperature of the cow may rise to 104 degrees F or higher. Within the day of onset, an infected quarter generally will become edematous (swollen) and sensitive to touch, and will sometimes secrete a small amount of serum-looking fluid. At this point, the infected cow will be weak and dehydrated, and may have a below-normal temperature (about 99 degrees F). Because the infection may result in a decreased level of blood calcium, an infected cow may appear to have symptoms of hypocalcemia (milk fever).

Herd signs:

- A high proportion of clinical mastitis cases that occur in the first 90 days after calving, often at the peak of lactation.
- Infections that last for a few hours/days.
- A herd somatic cell count of 200,000 or less, and few *Strep. ag.* and *Staph. aureus* infections (less than 10 percent of the herd).

Will a monthly DHIA somatic cell count (SCC) identify coliform-infected cows?

Not usually. DHIA somatic cell counts tend to identify clinical and non-clinical mastitis infections that are relatively long in length. Coliform infections are very short in duration (a matter of a few hours to a few days).

An infected cow's SCC may be low on test day, but can rise to several million within one to two days. Subsequently, since DHIA SCCs are taken at monthly intervals, cows that recover from the infection could have a normal SCC by the next test day. However, herds in which 85 to 90 percent of cows have linear scores of 4 or lower may be more likely to develop coliform infections than herds with higher SCCs. Thus, use of the DHIA cell count is more helpful to the herdowner in identifying cows that are "at risk" in developing coliform infections than in identifying coliform-infected cows.

SOMATIC CELL COUNTS AND EQUIVALENT DHIA LINEAR SCORES

Average Somatic Cell Count	DHIA Linear Score
12,500	0
25,000	1
50,000	2
100,000	3
200,000	4
400,000	5
800,000	6
1,600,000	7
3,200,000	8
6,400,000	9

What kind of treatment should I give infected cows?

Before treating clinically infected cows, aseptically collect a milk sample from the infected quarter so that the organism responsible for the mastitis infection can be identified. Though having a milk sample cultured may help to identify the type of organism responsible for the infection, be aware that coliform bacteria are not reliably cultured from milk of infected quarters. The numbers of coliform organisms in a milk sample from a clinically infected quarter may fall below the minimum detectable limit. This makes recognition of early clinical symptoms much more important in helping to ensure that proper treatments are initiated quickly to save the cow and her production abilities. Identifying the organism may also help you to diagnose and choose the proper treatment method for subsequent coliform

TABLE 1—Cow stall platform sizes

Use electric cow trainers. Dimensions from edge of curb to edge of gutter.

Cow weight	Stanchion stalls		Tie stalls	
	Width	Length	Width	Length
Under 1,200 lb	4'-0"	5'-6"	4'-0"	5'-9"
1,200-1,600 lb	4'-6"	5'-9"	4'-6"	6'-0"
Over 1,600 lb	Not recommended		5'-0"	6'-6"

SOURCE: Midwest Plan Service (MWPS) publication #7, "Dairy Housing and Equipment Handbook" (4th Ed., 1985).

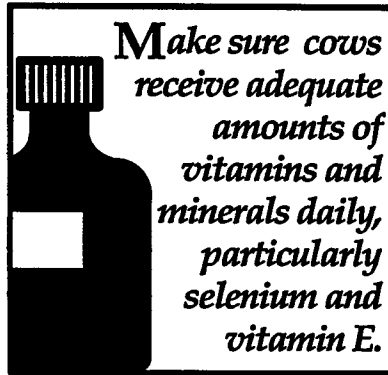
infections in other cows.

Most coliform cases require immediate professional veterinary treatment, which is likely to include use of broad spectrum antibiotics, fluid therapy, antiprostaglandin, steroids, antihistamines and calcium treatment. Aspirin is a potent antiprostaglandin that can be administered to infected cows by the herdowner, but this should be done upon the advice of the veterinarian.

A very important procedure in treatment of coliform mastitis infections involves frequent milking of the infected cow to remove leucocytes, bacteria and toxins from the mammary gland. Hourly milkings are very helpful. Injections of oxytocin following milking may also aid in removal of residual milk that contains toxins.

Besides treating infected cows, what management steps should I take to rid my herd of a coliform problem?

- Immediately clean up all areas that could be a source of bacterial growth. This may include poorly cleaned or pitted free stalls, an overused calving pen, a muddy lot, or an overcrowded shelter area used during hot or cold weather.
- Immediately remove sawdust bedding or other fine bedding (such as ground corn cobs,



recycled manure or chopped straw) from beneath high-producing cows, and avoid bedding dry cows and springing heifers within two weeks of calving on these materials. In addition, do not use manure packs as bedding materials for dry cows and springing heifers.

- Increase space per cow by providing a clean area, such as a pasture, so cows can avoid manure contamination. Cow numbers should not exceed 10 percent of the number of free stalls in the barn.
- Keep cows on their feet for an hour after milking by providing fresh feed for them to eat. This will allow the teat sphincter to regain its normal patency (closure status) after milking, before the teat end has a chance to be exposed to bedding and its contaminants.

Can milking management factors influence the occurrence rate of new coliform infections?

Despite the fact that the majority of new coliform infections occur between milkings, milking time infections can occur. A rise in the occurrence rate of new infections can be influenced by the following milking factors: wet milking of cows, i.e., the use of excessive water with no drying at prep time; excessive liner slippage and the potential for wet teats at the end of milking; and badly worn inflations. In addition, the combination of malfunctioning pulsators with any of the above problems can increase the chance that teat damage will occur, which in turn could increase the probability of new coliform infections.

To help avoid these problems, you should carefully wash and dry teats before milking to prevent accumulation of dirty water on teat ends. After milking, turn off the vacuum before removing teat cups to avoid liner slippage. Check milking equipment regularly to make sure it is functioning correctly. Note, too, that the use of automatic backflushing units will not control coliform infections since most infections occur between milkings.

TABLE 2—Free stall dimensions

Age (mo)	Weight (lb)	Stall size		Neck rail	
		Width	Length	Height above stall bed	Distance from front
----- inches -----					
6-8	360-490	30	60	28	14
9-12	490-650	33	64	30	15
13-15	650-780	37	72	34	15
16-24	780-1,200	42	78	37	16
cows	1,200-1,500	45	84	40	18
cows	over 1,500	48	90	42	19

SOURCE: "Improved Free Stall Partition Design," Agricultural Engineering Information Series #557, Michigan State University CES, August 1986.

Should I continue dry treating all cows?

Infusion of antibiotics specifically designed for dry cow usage at dry-off increases the cure rate and prevents most new infections in the early dry period. Most commercial dry cow therapy products are designed to cure *Strep. ag.* and *Staph. aureus* mastitis infections. Dry cow therapy should be used on every quarter and every cow to cure and prevent infections other than coliforms, and to prevent an increase in environmental streptococci infections during the first 7 to 10 days of the dry period.

Dry cow treatment will not prevent new coliform or environmental streptococci infections in the last two weeks of the dry period or at the start of the next lactation, however. Only good housing management from two weeks before and at calving will prevent the majority of new coliform infections that may tend to occur immediately after calving or during the early postpartum period.

Is there anything I can do to prevent or reduce the chances of my herd becoming reinfected with coliform infections once problems are eliminated?

Yes. A long-term prevention program should be part of any mastitis control program. For best results in the fight against coliform mastitis:

- Maintain/replace free stall bedding frequently to prevent the "hollowing out of the bedding" that allows milk, manure and urine to accumulate.
- Scrape the rear 2 to 3 feet of free stalls twice a day to prevent manure buildup.
- Make sure free stalls and comfort stalls are correctly designed for the size of the cows that will be housed in them. The right sized stalls will help to prevent teat injuries, which will lower the chances of coliform infections occurring. Tables 1 and 2 outline proper cow stall platform sizes

and free stall dimensions. For more information on dairy housing guidelines, ask your county Cooperative Extension Service agricultural agent where you can get Midwest Plan Service (MWPS) publication #7, "Dairy Housing and Equipment Handbook" (4th ed., 1985).

- Avoid housing dry cows and springing heifers that are within two weeks of calving on sawdust bedding, recycled manure solids, manure packs or muddy lots.
- Consider using sand instead of sawdust or recycled manure solids as a bedding material, particularly for early-lactation cows. Cows that are more than 90 days into a lactation, however, may be housed with any type of bedding.

What if my farm uses a liquid manure system and I can't use sand bedding for high-producing cows?

Under such conditions, chopped straw or wood shavings would be preferable to sawdust as a bedding source. It is critical that the back 2 to 3 feet of each stall be cleaned two to three times a day.

What about adding lime to the backs of stalls bedded with sawdust to limit coliform infections?

Research at the University of Vermont and other universities has indicated that this is a short-term solution at best. Using sand would be preferable to adding lime to sawdust bedding. Lime may cause drying and excessive chapping of teat skin.



North Central Regional Extension Publications are subject to peer review and prepared as a part of the Cooperative Extension activities of the thirteen land-grant universities of the 12 North Central States, in cooperation with Extension Service-U.S. Department of Agriculture, Washington, D.C. The following states cooperated in making this publication available.

University of Illinois
1301 W. Gregory Drive
Urbana, IL 61801
217-333-2007

Kansas State University
Umberger Hall
Manhattan, KS 66506
913-532-5830

***Michigan State University**
P.O. Box 6640
East Lansing, MI 48826-6640
517-355-0240

Lincoln University
900 Moreau Drive
Jefferson City, MO 65101
314-751-3797

University of Minnesota
3 Coffey Hall
St. Paul, MN 55108
612-625-8173

University of Missouri
115 S. Fifth St.
Columbia, MO 65211
314-882-7216

University of Nebraska
Dept. of Ag. Comm.
Lincoln, NE 68583-0918
402-472-3023

North Dakota State University
Dept. of Ag. Communications,
Box 5655
Fargo, ND 58105
701-237-7881



South Dakota State University
Ag. Comm. Ctr., Box 2231
Brookings, SD 57007
605-688-5628

University of Wisconsin
30 N. Murray St.
Madison, WI 53715
608-262-3346

***Publishing State**

For copies of this and other North Central Regional Extension Publications, write to: Publications Office, Cooperative Extension Service, in care of the University listed above for your state. If they do not have copies or your state is not listed, contact the publishing state as specified.

Programs and activities of the Cooperative Extension Service are available to all potential clientele without regard to race, color, sex, national origin, or handicap.

In cooperation with NCR Educational Materials Project

Issued in furtherance of Cooperative Extension work. Acts of Congress of May 8 and June 30, 1914 in cooperation with the U.S. Department of Agriculture and Cooperative Extension Services of Illinois, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. W. J. Moline, Director, Cooperative Extension Service, Michigan State University, East Lansing, Michigan 48824.

Printed and distributed in cooperation with Extension Service, U.S. Department of Agriculture, Washington, D.C.



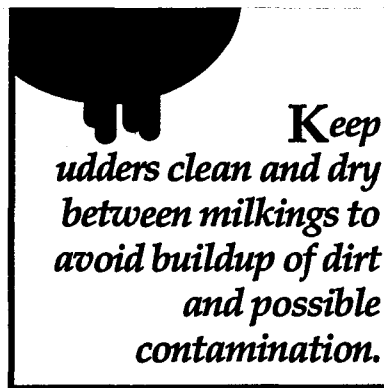
What about cementing free stalls to ease maintenance?

Cemented free stalls with a 4-inch slope from front to back, no back curb and a grooved surface, will decrease the labor cost of maintaining free stalls. A minimum of 3 to 4 inches of bedding must be maintained in the stalls to minimize feet and leg injuries. Consider using free stall mattress pads for this purpose. The use of fine sawdust or recycled manure solids for high-producing cows is still questionable on cemented free stalls.

Are there any other management steps I can take to cut down on coliform mastitis infections in my herd?

Yes. Consider adding these steps to your preventive maintenance list:

- Avoid overcrowding of free stall or loafing areas so that cows will not rest in alleyways.
- Provide well-ventilated and lighted housing areas to prevent environmental stress.
- Change feed rations and cow routines gradually to prevent stressful periods.
- Dip teats prior to milking with a germicidal teat dip. This practice has been shown to reduce the incidence of new cases of coliform and other environmental mastitis.
- Make sure that cows are receiving adequate amounts of vitamins and minerals in their daily rations, particularly vitamin E and selenium. Studies have indicated that deficiencies of vitamin E and selenium can contribute to an increase in the incidence of environmental mastitis. For lactating and dry cows, Michigan State University dairy nutrition specialists recommend a daily minimum of 300 IUs of vitamin E per cow. Additionally, in light of recent changes by the U.S. Food and Drug Administration in the amounts of supplemental selenium that dairy cattle can receive in their rations, MSU specialists recommend a daily



minimum of .068 pounds of Selenium 90 (200) Premix per cow, which provides the equivalent of 6 mg per cow.

- Clean and sanitize 12-foot by 12-foot calving areas after one or two freshenings. One box stall, bedded with long straw, should be available for every 15 to 20 cows.

Does teat dipping play any role in preventing coliform mastitis?

Germicidal teat dips are not effective against gram-negative organisms such as coliforms. Latex sealant dips may provide some physical protection against coliform invasion of teat ends between milkings, but to be effective, the latex dip must dry on the teat end before the cow lies down.

The prevalence of coliform infections decreases significantly after the first 90 days of lactation. Therefore, if your herd has had confirmed cases of coliform mastitis, try using a latex dip for high-producing cows and a germicidal dip for other production groups.

Would the use of an IMD (intramammary device) help to control coliform mastitis?

Research is continuing on the effect that inserting an IMD loop into cows' quarters has on prevention of coliform infections. Studies in Israel and at the U.S. Department of Agriculture in Beltsville, Md., indicate that the loop can stay in the gland cistern and stimulate

a localized increase in leucocytes, which could help to repel invading coliform organisms.

These research trials are studying the short-term and long-term effects of IMD on somatic cell counts, clinical mastitis and milk production. Because the loops cause a localized increase in somatic cell counts, there is concern that herds on milk quality payment programs may not qualify for bonuses traditionally awarded for low SCCs. In addition, it is still not clear what, if any, the long-term effects are of IMDs on milk production.

This is one in a series of bulletins on mastitis control in dairy herds. Contact your county Cooperative Extension Service office for information on other forms of mastitis and how to control them.